WATERSHED INITIATIVE GRANT PROPOSAL
FOR THE USRW,
ILLINOIS

HYDROLOGIC UNIT CODE 07130006

Proposal of the

Agricultural Watershed Institute

Prepared for submittal to the

Illinois Environmental Protection Agency

For consideration for nomination by

Governor Rod Blagojevich

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This proposal addresses hypoxia in the Gulf of Mexico.

Abstract: The USRW proposal includes a coordinated set of projects to improve water quality locally, regionally, and in the Gulf of Mexico by enhancing nutrient management for crop production and reducing loss of nutrients. One project will use GIS-based software and precision agriculture technology in on-farm experiments to optimize nitrogen management. Risk management instruments to protect farmers against income losses from reduced application rates will be demonstrated and refined. A second study will demonstrate drainage water management and subsurface bioreactors to reduce movement of nitrates through drainage tiles to surface waters. Cost-effectiveness will be evaluated, allowing for scoring this approach for Point/Nonpoint Source trading. The third study will address economic and environmental benefits from soil testing and variable rate technology to improve phosphorus management. Economic and environmental results will be measured. Stakeholders will evaluate projects, disseminate findings, and identify added strategies to improve nutrient management and reduce losses.

WORKPLAN (A) INTRODUCTION *(A1) Watershed Description.* The Upper Sanagmon River Watershed (USRW) located in Central Illinois, it's watershed above Lake Decatur dam covers 925 square miles in seven counties. Approximately 87 percent of the Lake Decatur watershed is in crop production. The topography is nearly level to gently undulating. Lake Decatur was formed in 1922 to provide water for domestic use, processing of agricultural products and as a recreational resource. The City's 2000 census was 81,860.

(A2) Threats and Impairments. Erosion and sedimentation from cropland and stream banks have been concerns since the lake's creation. Due to widespread tile drainage, erosive forces in the watershed have greatly increased. In addition, Lake Decatur (and several other surface water supplies in Illinois) have experienced nitrate concentrations at or above the 10 mg/l drinking water standard most years since 1980. The *Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico* states, "High nitrogen loads come from basins receiving wastewater discharges and draining agricultural lands in Iowa, Illinois, Indiana, southern Minnesota, and Ohio." Monitoring by the Illinois State Water Survey (ISWS) in the mid-1990s found the average annual nitrate yield to Lake Decatur to be 23 lb/acre.

(A3) Watershed Plan. The objectives of soil and water conservation efforts undertaken in the watershed are to

reduce the sediment and nutrient loads being delivered to the lake, and to do so without adversely affecting net farm income.

(A4) Assessments and Plans Completed. Decatur began its efforts at source water protection as early as 1941 when it employed two soil conservationists. Since 1985, the City has provided financial support for erosion and sediment reduction programs implemented by Soil and Water Conservation Districts (SWCDs) of Macon and other counties within the watershed.

In 1992, the City signed a Letter of Commitment to IEPA to comply with nitrate standards for drinking water. Monitoring of nitrogen compounds by ISWS began in 1993 and continues. Studies prepared for the City of Decatur in 1997-98 developed watershed strategies for reducing nitrates and sedimentation.

The USRW Committee was formed to assist in planning and to promote understanding and cooperation between urban and rural stakeholders. Several subwatershed plans have been or are being prepared through a locally-led resource planning process facilitated by the USDA/NRCS. A management plan for the portion of the watershed in Macon and Piatt Counties was developed in 2000. Goals in that plan include: (a) increased buffer acreage, (b) improved water quality, (c) reduced soil and streambank erosion, (d) preservation of wildlife habitat and protection of natural areas, and (e) restoration or construction of wetlands.

(B) DESCRIPTION OF THE PROPOSED STUDY PROJECTS *(B1) Effects on Watershed Health.* We propose three related projects addressing behavioral, technical and economic aspects of nutrient management. The projects are designed to improve water quality locally, regionally, and in the Gulf of Mexico by reducing unnecessary nutrient discharges from agricultural areas.

(B2) Project Descriptions. The goals, components, and impacts of each of these projects are described in-turn.

Project 1: On-farm trials of risk management measures to improve nitrogen fertilizer efficiency.

(B2.1i) Goals and Components. The major goal is to overcome behavioral and institutional obstacles to efficient nutrient management. Much evidence suggests that farmers generally apply more fertilizer for their crops than university recommendations. Over-application is often seen as a form of insurance against yield losses, but the financial returns to this insurance strategy may not justify the annual cost of the excess fertilizer. We will test at

a watershed scale the hypothesis that optimum application rates can increase expected net farm income while also reducing nutrient losses. A second objective is to develop risk management mechanisms (e.g., insurance arrangements) that farmers are willing to substitute for the use of excess nitrogen.

With funding from the City of Decatur and Illinois agricultural research programs, Macon County SWCD has conducted field studies of risk management concepts and methods. In those studies, within-field check strips were used as a basis for insuring cooperating farmers against income loss due to having reduced their nitrogen application to comply with published recommendations. The scale of this research has been modest, and attention focused on application rate. In the proposed project, farmers' experiences of nutrient BMPs will be tracked in larger, systematically designed field experiments. Water quality benefits will be modeled and monitored. The U of I Enhanced Farm Research Analysis (EFRA) software, with data-rich precision agriculture technology, allow researchers to test yield response to varied fertilizer rates, form, timing and practices at a much lower cost than traditional labor-intensive, small-plot trials.

The project will include advisory input from the USRW Committee and representatives of farm, input and environmental organizations. Farmers, crop advisers, fertilizer dealers and applicators will receive incentives to participate, farmers will be protected against income loss from reduced nutrient application.

The results from these field trials and similar trials in other Midwestern states will be used by the Agricultural Conservation Innovation Center (ACIC) and Agflex, Inc. to refine actuarial calculations for a Federal Crop Insurance Corporation approved pilot nutrient BMP insurance policy currently offered to corn growers in four states and an alternative private nutrient BMP risk management instrument. The ACIC (non-profit) and Agflex (for-profit), partner in developing and commercializing BMP risk management products for farmers. Expanded trials are needed to refine the instruments and expand awareness among insurers. Information developed in this project will be directly useful in designing and customizing market-based nutrient management instruments for application throughout the Upper Mississippi River Basin.

(B2.1ii) Schedule. Design and enrollment of farmers, completed before 2004 fall fertilizer application. On-farm trials will occur in 2005-2006. Analysis of results will take place following the second crop year.

(B2.1iii) Costs. (a) Personnel and expenses, AWI for project leadership, coordination and fiscal management; SWCD staff for producer relations, (nutrient management plan preparation); and researchers for study design and economic analysis; (b) Subcontracts for monitoring and modeling of water quality response; and (c) Incentive payments and funds to back insurance contracts or other market-based income security mechanisms.

(B2.1iv) Milestones. See the schedule, Section *(B2.1ii)* above.

Project 2: Demo of drainage management combined with subsurface denitrifying bioreactors.

(B2.2i) Goals and Components. The principal goal of this project is to improve technologies to reduce the movement of nitrates from the soil to surface waters via subsurface tile drains. It will evaluate nitrate removal performance of an improved subsurface denitrifying bioreactor design in combination with upstream water level and flow control in the tile system. Two to four systems will be installed and monitored. The technology demonstrated in this project is a good candidate for water quality trading. A distinct advantage for purposes of point/nonpoint source trading is the ability to directly measure the pollutant load removed by the system. Reports on system performance will contain cost effectiveness data suitable for use in scoring trades.

NRCS initiated a demonstration project in Illinois (1998) to assess crop production and water quality benefits of maintaining a raised water table during the fallow period by retrofitting tile outfalls with a simple water level control structure. Since 2002, NRCS has 37 sites project, including several in the USRW. Cost share financial assistance was provided to participating farmers through the Environmental Quality Incentives Program (EQIP) or Soil and Water Conservation Assistance (SWCA) program. NRCS has reported that monitoring of one of the sites showed a reduction in nitrate leaving the field of more than 40 percent.

Another promising technology for reducing nitrates in tile discharge is denitrification in subsurface bioreactors, “underground trenches filled with woodchips or other organic carbon sources that replace the last few hundred feet of a tile drain before it discharges” to a stream or main tile. U of I researchers have found nitrate removal efficiency to be about 25 percent in past studies. They hypothesize that performance can be substantially improved through an optimum combination of media composition and depth of overburden. One factor limiting

efficiency is that past designs a large percentage of the tile flow bypasses the bioreactor. The ability to control flow rates upstream of the bioreactor is expected to improve overall performance.

(B2.2ii) Schedule. Site selection, farmer/landowner arrangements, and design and installation of drainage control structures, bioreactors, and monitoring equipment will be completed by spring or summer 2005. Flow and upstream/downstream water quality data will be monitored for two years.

(B2.2iii) Costs. (a) Personnel and expenses for AWI for project management and data analysis, and SWCD staff for producer relations and data collection, (b) Subcontracts for researchers and laboratory analysis of tile water samples, and (c) Flow and sampling equipment and construction of tile structures and bioreactors.

(B2.2iv) Milestones. The results of these trials will be evaluated after the first and second full year of operation to determine removal efficiency and cost effectiveness for nitrates and other pollutants.

Project 3: Assessment of economic and water quality benefits of soil testing and variable rate technology for management of nutrients, especially phosphorus.

(B2.3i) Goals and Components. This project will be designed to increase the percentage of farmers using variable rate technology (VRT) and demonstrate to them that applying fertilizer at U of I recommended rates will save them money, while not adversely affecting yield. Water quality benefits of improved phosphorus management will be monitored and modeled for a subwatershed in the USRW. If, as expected, this study demonstrates that soil testing and VRT can reduce producer input costs without loss of yield, long term economic and water quality benefits are expected to be the result as these practices are continued by participating farmers and adopted by other farmers without need for incentive payments.

An incentive payment will be made to farmers who agree to: take current soil samples on a 2.5 acre grid basis, apply phosphorus and potassium using VRT and U of I agronomic recommendations, follow U of I recommendations for nitrogen applications for corn, and provide information on their nutrient practices before and after participating in the program. No phosphorus will be applied to any portion of a field with a soil test phosphorus level at or above 70 lb/ac. Based on soil test results in other watersheds, it is estimated that 50 to 60 percent of cropland will exceed this threshold. A payment will also be made to Technical Service Providers (TSPs)

who perform the soil sampling and develop the nutrient management plan. TSPs will participate in collecting and analyzing nutrient practices for crop years before and after implementation of soil testing.

An effort will be made to obtain soil test results for both the standard (7 inch depth) test and the upper two inches of soil to assess the extent of stratification of P in the soil. This information will be useful in assessing water quality impacts of P in runoff and planning management practices to reduce these impacts.

(B2.3ii) Schedule. Selection of the target subwatershed, enrollment and other arrangements with producers and TSPs will be completed by spring 2005. Soil tests and nutrient plans will be completed and implemented starting in the 2005 crop year with full implementation for the 2006 crop. Economic and water quality results will be monitored throughout the study period and documented following the 2006 harvest.

(B2.3iii) Costs. (a) Incentive payments to producers and TSPs for participation in the program (shown in the "Other" budget line), (b) Costs for AWI and SWCD staff involved in project administration and analysis of the results, and © Monitoring and modeling subcontracts for assessment of water quality benefits.

(B2.3iv) Milestones. An economic evaluation will be performed after each crop year to determine the results to participating producers in input cost savings and effect on net income (crop value minus inputs). Environmental indicators, mainly phosphorus concentrations and loads in the target watershed and a reference watershed, will be measured throughout the project and assessed after the second crop year (fall 2006).

(B3) Monitoring and Evaluation. These costs are included in the budget for each project. Illinois State Water Survey already monitors nitrogen compounds in the watershed with financial support from the City of Decatur. Monitoring stations and parameters will be added to assess benefits of improved N management in Project 1 and P management in Project 3. ISWS will follow QA/QC protocols and enter their data in the STORET system. Short term monitoring may not pick up measurable reduction of nitrates from improved fertilizer management. Therefore, water quality modeling will also be done to estimate the benefits of long term application of the nutrient management strategies throughout the watershed. It is expected that modeling will be subcontracted to Limno-Tech Inc. and agricultural economist David White of the University of Illinois who performed water modeling for the Lake Decatur nitrate study. It is anticipated that sampling and testing to assess benefits of the linked drainage water

management and subsurface bioreactors (Project 2) will be done by the UI Agricultural Engineering laboratory, as in past studies of subsurface bioreactors.

(B4) Relationship to Other Programs or Mandates. Previous efforts in the USRW to reduce nitrates and sediment were undertaken for protection of Lake Decatur, although they began long before the Source Water Assessment and Protection program (1996 Safe Drinking Water Act Amendments). Decatur has constructed ion exchange facilities to ensure reliable compliance with the nitrate MCL but continues to support nitrogen management in the watershed to minimize operating costs and ensure that treatment capacity will not be exceeded by high nitrate concentration in the lake. Local experience with innovative nutrient management strategies, an extensive data record from past water quality monitoring, and the importance of crop production and agri-business in the local economy make the USRW an excellent location to study concepts to meet water quality and drinking water standards and reduce nutrient loads impacting the Gulf of Mexico.

(C) DESCRIPTION OF PROJECT MANAGEMENT

The Agricultural Watershed Institute will be the grantee, fiscal agent, and management entity for the projects in this USRW proposal. AWI is a 501(c)(3) nonprofit institute incorporated in the State of Illinois. It conducts research and educational programs on practices and policies that improve water quality, maintain or restore ecosystem health, and conserve and manage land and water resources in agricultural watersheds. The USRW is the home watershed of AWI. AWI was incorporated in February 2003 following an 18-month period of planning and preparation. Core focus areas include management of agricultural inputs.

Stephen John: member of the AWI Board of Directors and acting Executive Director. He will be the grant administrator and project coordinator for the projects in this proposal. Mr. John is an environmental planner and president of Environmental Planning and Economics, Inc. As a Decatur City Council member, he co-chaired the USRW Committee and later served as project manager for watershed studies to reduce nitrates and erosion/sedimentation impacting Lake Decatur. He gained experience in stakeholder involvement to address complex policy issues as the National League of Cities representative on the EPA CSO work group. He chairs the Watershed Committee of the Illinois Water Environment Association.

John Braden: AWI Board member, will provide oversight and guidance for the research design of all projects in this proposal and will participate in the nitrogen management project. Dr. Braden is Professor of Environmental Economics at the U of I. He conducts research on water quality, market-based environmental protection, and environmental benefits. He formerly directed the Illinois Water Resources Center and the UI Environmental Council and has been principal investigator on projects involving more than $5 million.

Doug Kane: will lead the analysis of market strategies and policies for nutrient management. Dr. Kane has experience as an environmental economist, state legislator and working farmer. He served for eight years as an Illinois State Representative, worked on the Illinois Governor's staff and as deputy auditor general of Illinois. He consults on environmental economics and governmental program evaluation and operates a dairy farm. He was senior economist on the Lake Decatur nitrate study and now serves as an AWI adjunct researcher and policy analyst.

Key participants in the nitrogen risk management study (Project 1) include: **David Bullock**, **Madhu Khanna**, and **Nicholas Brozovic**, U of I Associate Professors in the Department of Agricultural and Consumer Economics and **Donald Bullock**, Professor of Crop Production in the Department of Crop Sciences. They conduct research on optimization of nitrogen application to improve water quality and have developed and refined the EFRA software and methods to be applied in the proposed research. **Brian Brandt** of ACIC and **Thomas Green** of Agflex will develop risk management instruments and perform actuarial analysis of data from the study. **Shannon Allen** of Macon County SWCD has directed the nitrogen verification plot studies for three years. He will supervise the work of the county SWCDs with participating producers.

Donald Pitts and **Richard Cooke** will lead the study of drainage water management and subsurface bioreactors (Project 2). Mr. Pitts is the NRCS State Water Quality Specialist and Agricultural Engineer for Illinois. Dr. Cooke is a UI Associate Professor of Agricultural Engineering.

Leon Wendte and **Britt Weiser** of NRCS and **Bruce Stikkers** of Champaign County SWCD will head the study of soil testing and variable rate technology for improved P management.

Monitoring will be performed by the Illinois State Water Survey under the direction of **Misganaw Demissie** and **Laura Keefer**. Modeling will be performed by Limno-Tech Inc., under the direction of **David Dilks**, and by

David White, a Principal Research Specialist in the U of I Department of Agricultural and Consumer Economics.

(D) DESCRIPTION OF OUTREACH ACTIVITIES

AWI will coordinate an outreach process that engages USRW Committee members plus invited experts, governmental policy makers/program managers, and representatives of agricultural/environmental organizations in evaluating projects in this proposal, disseminating findings, and identifying added strategies to improve nutrient management and reduce nutrient enrichment of fresh waters and the Gulf of Mexico. The process produce an action plan for watershed projects or programs with local economic and environmental benefits and to serve as a model for watershed planning to address far downstream impacts of NPS pollution.

We anticipate holding quarterly half-day meetings throughout the grant period to discuss project results and additional strategies, with at least two one-day workshops to develop a plan for future actions to reduce nutrients in surface waters. Nutrient reduction strategies studied in this project will generally be suitable for application throughout the Corn Belt. During the grant period, AWI will sponsor or co-sponsor at least one major conference on this topic. If requested by EPA, outreach activities in this grant can be formally linked to the *Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico* which calls for the development of sub-basin nutrient reduction strategies.

Researchers and other participants will present methods, findings and lessons from this project in various forums to academic, professional, agri-industry, and environmental audiences. This is viewed as a regular part of AWI's work and is not included in the budget.

Budgeted costs for outreach include AWI personnel and related costs (including travel and lodging for the annual National Watershed Initiative Conference), a subcontract for professional facilitation, and compensation and travel expenses for outside experts invited to present information to the stakeholder work group. Stakeholders will not be compensated for their time but may be reimbursed for travel expenses; the value of donated time is included in the non-federal match.

Table 1. BUDGET INFORMATION - USRW Grant Proposal[1]

Summary: Watershed Project, Activity or Work Plan Element	Federal	Non-Federal	Total
1. Nitrogen risk management	$731,782	$354,656	$1,086,438
2. Denitrifying bioreactors w/drainage management	$171,281	$79,500	$250,781
3. Soil testing and VRT for P management	$279,313	$74,937	$354,250
4. Outreach activities	$113,544	$90,281	$203,825
Totals	$1,295,920	$599,374	$1,895,294

	Watershed Project, Activity or Work Plan Element				Total
Budget Categories	(1)	(2)	(3)	(4)	
a. Personnel	$271,875	$87,750	$48,000	$39,000	$446,625
b. Fringe Benefits	$78,750	$21,938	$12,000	$9,750	$122,438
c. Travel	$2,000		$1,000	$7,200	$10,200
d. Equipment		$13,000			$13,000
e. Supplies			$2,000	$5,000	$7,000
f. Contractual	$380,000	$82,500	$60,000	$15,000	$537,500
g. Construction		$20,000			$20,000
h. Other	$234,000		$214,000	$102,000	$550,000
I. Total Direct Charges (sum line a-h)	$966,625	$225,188	$337,000	$177,950	$1,706,763
j. Indirect Charges	$119,813	$25,593	$17,250	$25,875	$188,531
TOTALS (sum line I-j)	$1,086,438	$250,781	$354,250	$203,825	$1,895,294